FAG

Radiation
Measuring Technology

Operating Manual for the

FAG FH 40 F1-F6 RADIAMETER

FAG Kugelfischer Georg Schäfer KGaA

DB-001-860612 E

Dose rate meter in accordance with DIN 6818 ___
Dose rates up to 10 Sv/h (1000 R/h)

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FAG FH 40 F1-F4
RADIAMETER

Revision sheet

Rev.	Rev. date	Respons. departm.	Name	Rev. page	Cat. *)	Explanation
A	24-11-87	SM-VE-P	Lo.	10, 34,43, 36	I A C	brief instructions
B	22-01-91	SM-VE-P	Lo.	2,36,42, 54	C A	short instructions

*) Category C: editorial correction
I: clearing improvement
A: substantial alteration

Explanation given for category A

22.01.1991 Lorenz/mü

Contents

I. FH 40 F Basic Meter

Purpose and description

1.
The FH 40 F basic meter is used for measurement of gamma and X-radiation. Design approval for calibration (FH 40 F1 ... F4) and approval for use in fire services (FH 40 F1/F3) have been received.

2.
According to the desired dose rate range there are four versions of the basic meter available:

Type	Measuring range *)	Counter tube
FH 40 F 1	3 µSv/h ... 1 Sv/h	ZP 1310
FH 40 F 2	0,01 µSv/h ... 10 mSv/h	ZP 1200
FH 40 F 3	300 µR/h ... 100 R/h	ZP 1310
FH 40 F 4	1 µR/h ... 1 R/h	ZP 1200

*) As from 1981 the legal unit for dose rate equivalent is "Sievert per hour" (Sv/h).

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3.

A Geiger-Müller counter tube us used as radiation detector. The counter tube (type summary see point 2.) is installed in the basic meter and lies transversely in front of the end face of the meter.

Power supply is either by means of 9 volt dry batteries type IEC 6 LF 22 or suitable accumulators.

3.1

The standard battery (zinc-manganese element) is the cheapest form for daily use at normal temperatures. It has a short storage life and suffers a considerable capacity loss even at 0 °C.

3.2

Alkali-manganese cells are distinguished by their very much higher capacity and longer storage life. The capacity loss at low temperatures is less. The higher price is justified when conditions demand.

3.3

Lithium cells have good capacity with excellent storage life. The capacity loss at low temperatures is low. On account of the high price this cell should be reserved for special use.

Operating life will depend on the capacity of the cells.

Example:

When using a 9 volt IEC 6 LF 22 alkali-manganese battery the operating life when measuring normal environmental radiation (without scale illumination) will be a minimum of 70 hours. Switching on the scale illumination will reduce the operating life considerably.

4.
The basic meter incorporates:

- 1 FH 40 F1, F2, F3 or F4 radiameter
  with stick-on summary operating instructions.

- 1 carrying strap

5.
The case of the FH 40 F radiameter is of impact resistant plastic and can readily be recontaminated.

The meter is splash waterproof in accordance with DIN 40 050, degree of protection IP 65.

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6.
On the top of the meter (Figure 1) are the following:

- Readout scale (1)
- ON/OFF button ⊙ (2)
- Readout illumination button ☼ (3)
- Audible indication button (4)
- Yellow arrow to indicate direction of incidence of radiation (5)

7.
The end face of the meter has a

- circular yellow mark (6)
  for applying a test source.

8.
On the lefthand side of the case (Figure 1) is fitted the

- connection socket for an external probe.

9.
On the back of the radiameter are the

- battery compartment cover (8)
- and an adhesive plate with summary operating instructions (9).

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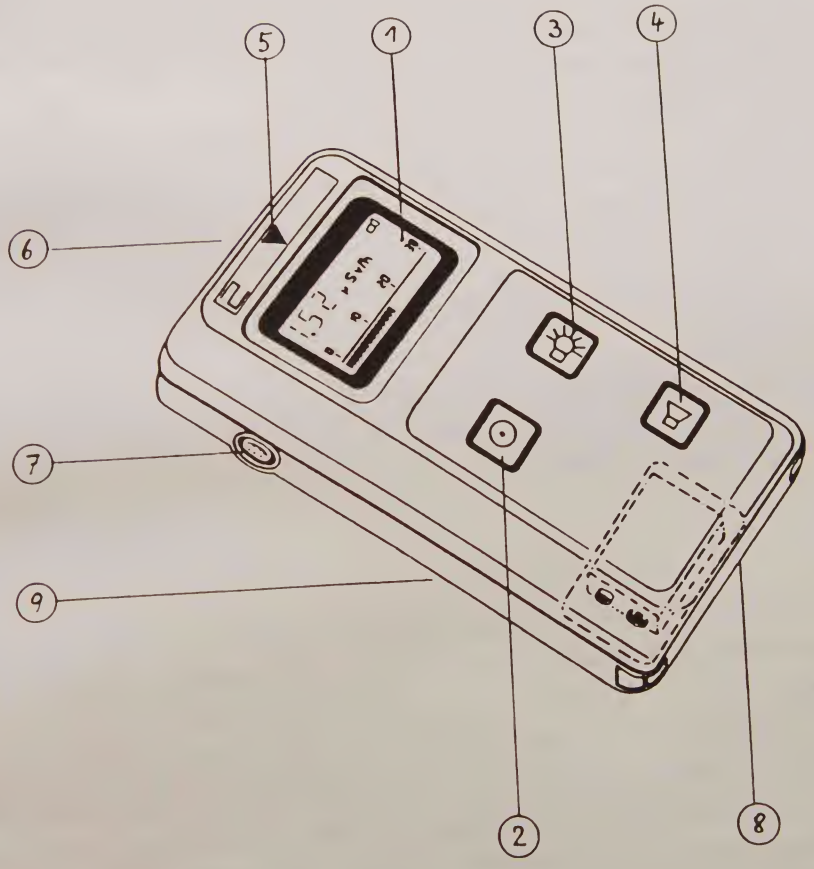

Fig. 1

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Checks and battery changing

10.
Directly after switching the meter on with button ⊙ the microprocessor automatically carries out a test program.

During the course of this test the scale illumination and audible indication are briefly switched on. In addition the following will appear in the display:

- the figures "8.8.8."
- the dimensions "µR/h" and "µSv/h"
- the battery symbol

If a fault in program execution is detected during the test, "Err" (= error) will appear on the display. This prevents the use of a defective meter.

During operation the microprocessor continuously checks the battery voltage. If this drops below a value of 6 V, the battery symbol will flash in the display. As soon as the battery voltage is no longer sufficient for operation (threshold = 5 V) the "Err" symbol and the battery symbol are visible simultaneously.

11.
To open the battery compartment undo the screw on the back of the meter with a coin and pull back the metal cover. Connect a 6 LF 22 9 volt battery to the cable connector in the meter. Wrong polarity connection is not possible !

Close battery compartment cover and screw in position.

12.
Power supply for training establishments and practice as well as for "Kat-S" applications in peacetime and "V-Fall" will basically be effected by dry batteries of type 6 F 22 (zinc battery) or 6 LF 22 (alkali-manganese battery).

13.
If dry batteries are difficult to obtain, a 9 volt lithium battery should be used for power supply. This has a storage life of approximately 10 years at storage temperatures of +15 to +28 °C.

To utilize their capacity lithium batteries should be used approximately 1 year before elapse of their storage life.

14.
The batteries should be removed from the meter after use and stored in a dry place. Discharged batteries should be kept separately.

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Measurement of gamma radiation with the basic meter

15.
Gamma radiation can be measured with the counter tube fitted (integral counter tube).

To measure the dose rate of gamma radiation the end face of the radiameter should be aligned with the radiation source. When tracing radiation in a radioactively contaminated area the user should carry the radiameter slung in front of his body at a height of approximately 1 m (waist height). The meter should be held parallel to the ground so that the display can be read off conveniently.

The measured value is displayed both digitally by means of a numeric readout and also in analog form by the length of a bar.

The meter switches over automatically to the display range necessary in each case (scale and unit of measurement) so that the measured value can be read off directly at all times (autoranging).

When the measuring range is exceeded, 999 will flash on the display and the analog bar reaches maximum length.

When the range of indication is not being reached, 0 appears on the display and the bar is not visible.

16.
To obtain accurate measurement irradiation must take place at right angles to the circular mark on the end face of the radiameter. Where the location of the radiation source is unknown it will be necessary therefore to optimize the reading by tilting the case upwards and downwards and to the sides.

With large area radioactive contamination the gamma radiation will strike the radiameter from all directions.

The user must therefore obtain an average from several instantaneous values measured 1 m above the ground.

For this purpose he should turn round on the spot at the place of measurement and determine the average from four individual measurements obtained from turning through 90 ° in each case.

When measuring low dose rate values the readout will fluctuate statistically about its mean value.

The dose rate value to be given will then be the average of several instantaneous values each of which should be read off at a constant rate in sequence (e.g. average of 10 instantaneous values read off at intervals of 10 seconds).

Audible indication of single pulses

17.
For audible indication of single pulses the FH 40 F radiameter incorporates an acoustic generator which is switched on with the [□] button. The same symbol will also appear in the display.

Audible indication of radiation is particularly suitable for tracing low level radioactivity, also for example when searching for radioactive sources or for contamination checking with Geiger-Müller counter tubes, as the audible indication (whistling) takes place almost instantaneously, practically without delay, whilst a readout requires a certain response time.

As in the most sensitive measuring ranges of the radiation meter the natural environmental radiation will still be indicated (approx. 0,2 µSv/h or 20 µR/h), it is also possible by counting out the pulses to detect radioactivity of this nature which stands out only slightly from the background. The counting out time should be at least 1 minute.

Alarm

18.
In the case of meters with integral high dose counter tube, i.e. types FH 40 F1 and F3 the acoustic generator emits a warning sound as soon as the measured value exceeds a threshold of 25 µSv/h or 2,5 mR/h. At the same time alarm status is indicated by a flashing acoustic generator symbol in the display.

The warning sound can be switched off by depressing the button. The flashing sign will however remain as long as the alarm threshold is being reached.

19.
To switch off the meter press the ⊙ button.

For dose rate measurement of X radiation one proceeds in the same way as for measurement of gamma radiation.

Care, maintenance and storage

20.
Radiameters and accessories should be protected from dropping and impact and if possible from moisture and contamination (carrying case or contamination-proof bag).

Before use, the carrying strap should be attached to the radiameter. When used as dose rate meter and when checking persons and objects for contamination the meter should only be used with carrying strap looped round the neck as a precaution against dropping it.

After use in wet weather or snow all components of the radiation meter should be taken out of the carrying case and dried at room temperature.

Dirty components should be cleaned with a moist cloth and then dried.

If this method of cleaning is insufficient with contaminated meters to remove the radioactive contamination, the meters should be decontaminated using a soft brush with luke warm decontamination solution (0,5 % decontaminant: alkaline detergent in water) or with a commercially available detergent for delicate fabrics.

When carrying out care and maintenance on the radiation meter only the battery compartment may be opened.

The contacts must be kept free from corrosion.
Radiation meters may only be stored with batteries removed.

The most favourable storage temperaturs for radiation meters and batteries is between 15 ° and 28 °C.
The storage area must be dry and free from corrosive gases.

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Appendix 1

Specification

Measured variable	:	Photon dose rate equivalent (in Sv/h) or standard ion dose rate (in R/h)
Measuring range with integral high dose counter tube ZP 1310	:	$2 \cdot 10^{-4}$ ... 0.99 Sv/h ($2 \cdot 10^{-2}$ ... 99 R/h)
with integral low dose counter tube ZP 1200	:	$5 \cdot 10^{-7}$ ... $9.9 \cdot 10^{-3}$ Sv/h ($5 \cdot 10^{-5}$ ... 0.99 R/h)
Limits of error due to influence of energy	:	± 30 % in the range from 40 keV ... 3 MeV for FH 40 F1/F3 in the range from 45 keV ... 1,3 MeV for FH 40 F2/F4
directivity	:	± 20 % in the range ± 45 °

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due to influence of temperature	:	± 20 % in the range from -30 ... +50 °C
due to influence of atmospheric pressure	:	± 5 % referred to a reading at 1013 hPa for a surrounding air pressure between 300 and 1300 hPa
due to influence of atmospheric humidity	:	± 5 % referred to a reading of 60 % relative humidity in the range from 0 to 95 % relative humidity
Indication error (calibration error)	:	20 % at Cs-137 radiation (662 keV)

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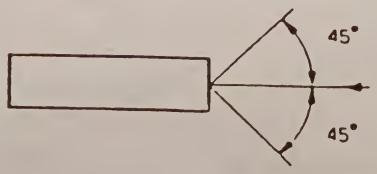
Directivity

Variation of the measured value/value of the measured variable ratio due to direction of incidence of the radiation remains within the nominal range in the limits specified below.

Reference value: preferred direction

q is the ratio of the displayed measured value to the correct measured value.

q_o is the value for q in the case of irradiation in preferred direction. Irradiation along plane perpendicular to the counter tube axis (see drawing):



	For radiation energy	
	65 keV 1,3 MeV (FH 40 F2/F4) resp.	3 MeV (FH 40 F1/F3)
Nominal range	± 45° to preferred direction	± 45° to preferred direction
Reference value	preferred direction	preferred direction
Limit value	$0,8 < q/q_o < 1,2$	$0,8 < q/q_o < 1,2$

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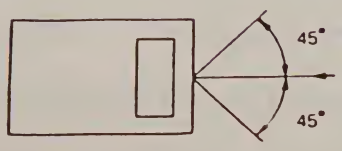
Irradiation along plane of indicating scale (see drawing):



Preferred direction

	For radiation energy		
	65 keV	1,3 MeV (FH 40 F2/F4) resp.	3 MeV (FH 40 F1/F3)
Nominal range	± 45° to preferred direction	± 45° to preferred direction	
Reference value	preferred direction	preferred direction	
Limit value	$0,8 < q/q_o < 1,2$	$0,8 < q/q_o < 1,2$	

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Measurement and indication ranges

Meter	Indication range	Measurement range
FH 40 F1	3 µSv/h - 1 Sv/h	200 µSv/h - 0,99 Sv/h
FH 40 F2	0,01 µSv/h - 10 mSv/h	0,5 µSv/h - 9,9 mSv/h
FH 40 F3	300 µR/h - 100 R/h	20 mR/h - 99 R/h
FH 40 F4	1 µR/h - 1 R/h	50 µR/h - 0,99 R/h

Detectors (Geiger-Müller counter tubes)

Meter	Detector
FH 40 F1	ZP 1310
FH 40 F2	ZP 1200
FH 40 F3	ZP 1310
FH 40 F4	ZP 1200

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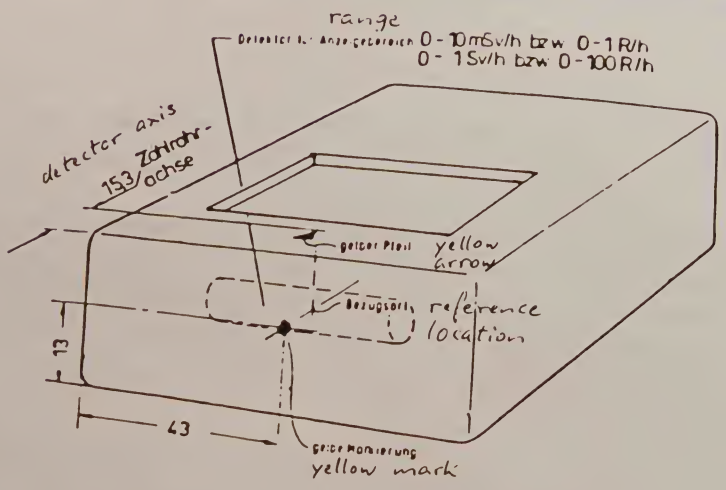
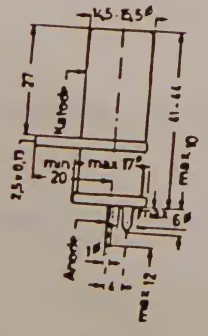
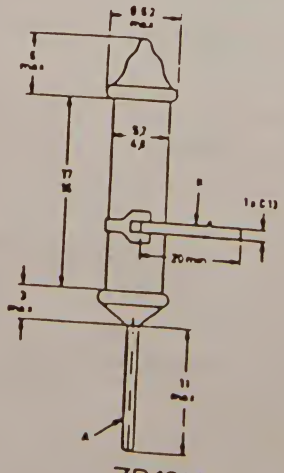
Position and dimensions of counter tubes





ZP 1200



ZP 1310

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Variation of reading (DIN 1319)

The reading does not vary with the dosimeter in any position.

After-effect

With meters FH 40 F1 and FH 40 F3 the error due to the after-effect of short time exposure to a radiation of a maximum of 10 000 R/h is negligible.

With meters FH 40 F2 and FH 40 F4 the upper limit is 1000 R/h.

Warm up and response time (DIN 6818 Part 1)

Scale		Response time	
		FH 40 F2/ FH 40 F4	FH 40 F1/ FH 40 F3
0 ... 1 µSv/h	0 ... 100 µR/h	90 s	-
0 ... 3 µSv/h	0 ... 300 µR/h	45 s	-
0 ... 10 µSv/h	0 ... 1 mR/h	35 s	-
0 ... 30 µSv/h	0 ... 3 mR/h	35 s	-
0 ... 100 µSv/h	0 ... 10 mR/h	15 s	40 s
0 ... 300 µSv/h	0 ... 30 mR/h	10 s	25 s
0 ... 1 mSv/h	0 ... 100 mR/h	8 s	20 s
0 ... 3 mSv/h	0 ... 300 mR/h	8 s	10 s
0 ... 10 mSv/h	0 ... 1 R/h	8 s	8 s
0 ... 30 mSv/h	0 ... 3 R/h	-	8 s
0 ... 100 mSv/h	0 ... 10 R/h	-	8 s
0 ... 300 mSv/h	0 ... 30 R/h	-	8 s
0 ... 1 Sv/h	0 ... 100 R/h	-	8 s

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Power supply	:	9 volt alkali-manganese battery conforming to IEC 6 LF 22 or lithium battery 9 volt or accumulator
Operating life	:	min. 70 hours in normal ambient radiation with alkali-manganese battery (without scale illumination)
Measured value display	:	LCD; in digital form by means of 3 digit value with appropriate unit of measurement. In analog form by means of bar along linear scale, autoranging.
Battery check	:	flashing of battery symbol when battery voltage is too low.
Audible single pulse indication	:	sound level 85 dB(A) at a distance of 10 cm
Dimensions	:	approx. 160 mm long approx. 85 mm wide approx. 40 mm high
Weight	:	approx. 500 g (with battery)

The meter is splashproof in accordance with DIN 40 050, degree of protection IP 65.

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Time constant in FH 40 F1/F3

The given values of time constant are valid, if no great changes of dose rate occur. Otherwise the time constant will be less.

Time constant [s]	FH 40 F1/F3	External FHZ 130 (high dose)	probe FHZ 173 (ß/γ)
	0 ... 20 µSv/h	0 ... 80 µSv/h	
40	0 ... 2 mR/h	0 ... 8 mR/h	0 ... 2,5 s^{-1}
20	20 ... 200 µSv/h	80 ... 800 µSv/h	
	2 ... 20 mR/h	8 ... 80 mR/h	2,5 ... 25 s^{-1}
	0,2 ... 2 mSv/h	0,8 ... 8 mSv/h	
8	20 ... 200 mR/h	80 ... 800 mR/h	25 ... 250 s^{-1}
	2 ... 20 mSv/h	8 ... 80 mSv/h	
2	0,2 ... 2 R/h	0,8 ... 8 R/h	250 ... 1000 s^{-1}
	20 ... 1000 mSv/h	0,8 ... 10 Sv/h	
1	2 ... 100 R/h	8 ... 1000 R/h	

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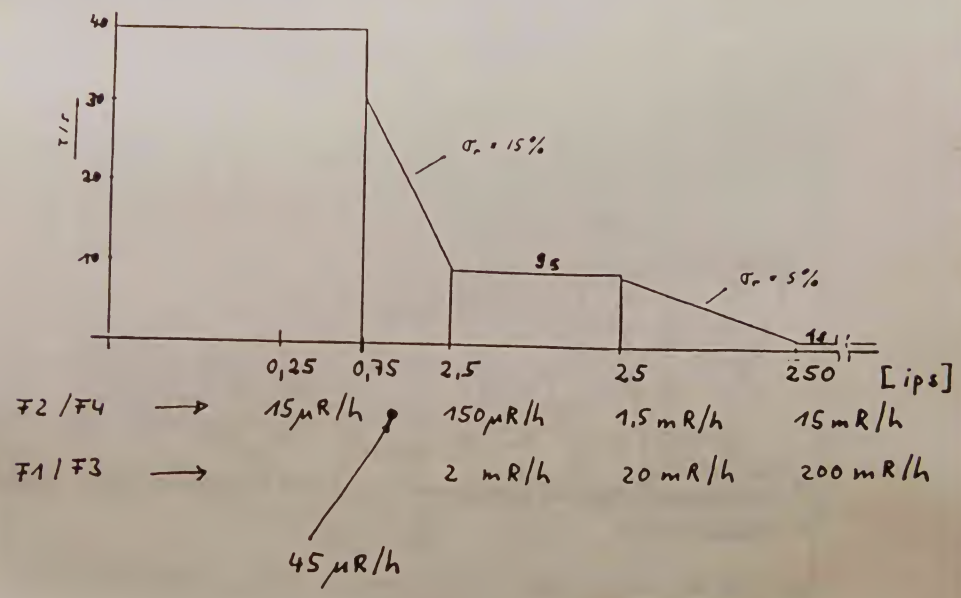
Time constant in FH 40 F2/F4

The models FH 40 F2 and F4 are to measure also small dose rates at a high accuracy. Therefore they have got a different dependency between time constant and dose rate as shown below:



Time constant of FH 40 F2/F4

Fig. 3

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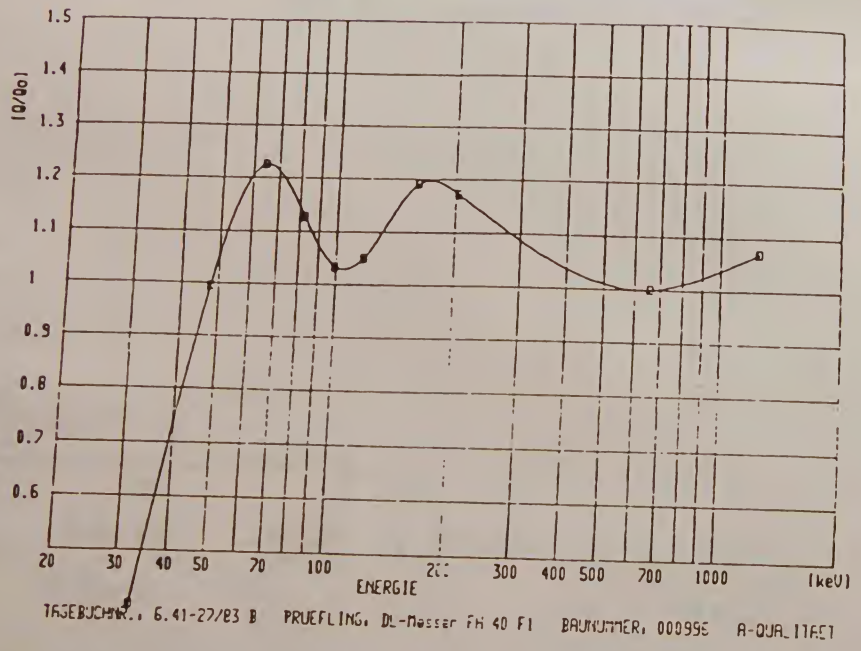

FH 40 F1/F3 Energy dependance of reading

Fig. 4

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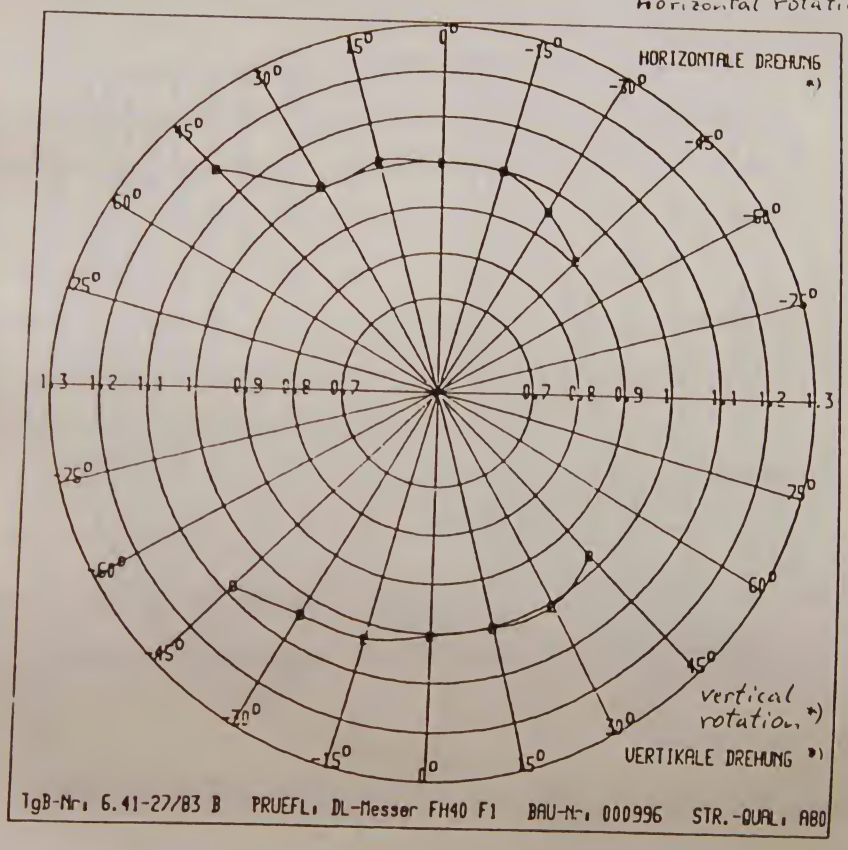
horizontal rotation *)



FH 40 F1/F3 Directivity of reading
in angular range -45° ... +45°

Fig. 5

*) see page no. 17/18

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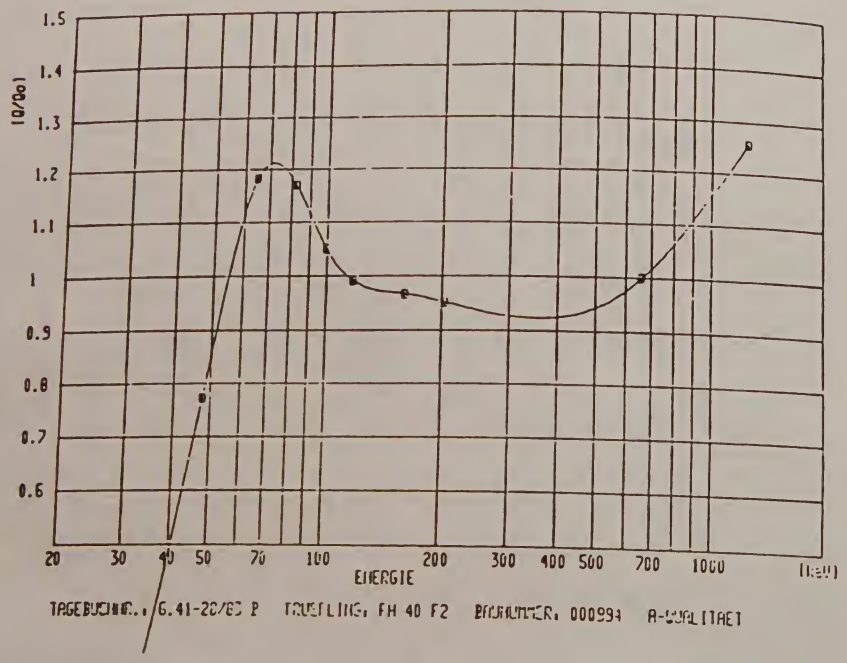

FH 40 F2/F4 Energy dependance of reading

Fig. 6

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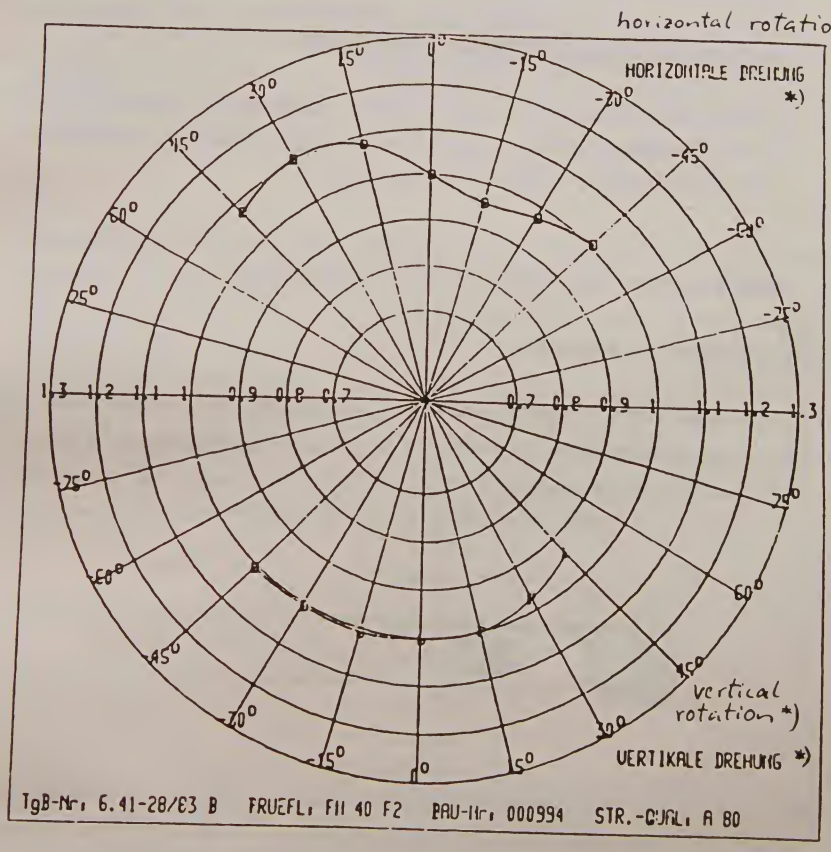

FH 40 F2/F4 Directivity of reading
in angular range -45° ... +45°

Fig. 7

*) see page no. 17/18

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Appendix 2

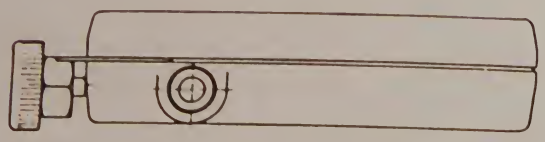
Check measurements with FH 35 D test source

An FH 35 D test source is available for checking the function of the FH 40 F dosimeter and for measuring the check reading in accordance with the Calibration Validity Regulations.

Check measurements are carried out as follows:

1.) Switch on FH 40 F.

2.) According to drawing below put the source holder completely into the groove of FH 40 F.



3.) Take source head out of the source container and screw it completely into the hole at the source holder.

If the meter is OK this check will provide a reading of 40 to 100 µSv/h or 4 ... 10 mR/h.

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Correction factor k_z for radioactive disintegration

Radionuclide	Caesium 137
Half-life	30,0 years

For comparison of the check readings α'_k measured at various times a dosimeter in the same checking equipment under the same conditions the reduction in dose rate at the place of measurement due to activity reduction of the source due to radioactive disintegration must be eliminated using the correction k_z.

Using this correction, the check reading α'_k (t) measured at a point in time t is converted to the value α_k (o) which would have been obtained at the reference point in time t = 0. Thus:

$$\alpha_k (o) = k_z \cdot \alpha'_k (t).$$

A tabular value of k_z given for time (t) should also be used for the times which lie within the period (t - 3) months and (t + 3) months.

Time after reference point in time years	months	k_z	Time after reference point in time years	months	k_z
0	0	1.000	16	0	
0	6	1.012	16	6	1.447
1	0	1.023	17	0	1.464
1	6	1.035	17	6	1.481
2	0	1.047	18	0	1.498
2	6	1.059	18	6	1.516
3	0	1.072	19	0	1.533
3	6	1.084	19	6	1.551
4	0	1.097	20	0	1.569
4	6	1.110	20	6	1.587
5	0	1.122	21	0	1.606
5	6	1.136	21	6	1.625
6	0	1.149	22	0	1.643
6	6	1.162	22	6	1.662
7	0	1.176	23	0	1.682
7	6	1.189	23	6	1.701
8	0	1.203	24	0	1.721
8	6	1.217	24	6	1.741
9	0	1.231	25	0	1.761
9	6	1.245	25	6	1.782
10	0	1.260	26	0	1.803
10	6	1.275	26	6	1.823
11	0	1.289	27	0	1.845
11	6	1.304	27	6	1.866
12	0	1.320	28	0	1.892
12	6	1.335	28	6	1.910
13	0	1.350	29	0	1.932
13	6	1.366	29	6	1.954
14	0	1.382	30	0	1.977
14	6	1.398			2.000
15	0	1.414			
15	6	1.431			

With a calibrated dosimeter the calibration error limits must be maintained at the moment of calibration and when in use at any other time (not calibration) the operating error limits, i.e. 1,2 x the calibration error limits must be maintained. Thus the overall error which is obtained from the deviation q of the indicated measured value from the true measured value during calibration and from the change in q during the period between calibration and any time during its use (not calibration) may not exceed the operating error limits.

The operating error limit for the FH 40 F radiameter is ± 24 %. At the time of calibration the check reading of the calibrated dosimeter is measured with the aid of the FH 35 D test soure belonging to the dosimeter. In the calibration certificate the calibration authority states the limit within which the check reading may vary after calibration without the operating error limits being exceeded.

Specification

Source model	FH 35 D
Nuclide	Cs-137
Half-life	30,0 years
Radioactivity	333 kBq ≙ 9 µCi
Source holder	draw. no. 42 482/5150
Weight	approx. 120 g
Check reading	40 ... 100 µSv/h or 4 ... 10 mR/h
Reproducibility of check reading	< 5 % of indicated value
Correction of check reading due to activity drop	see table

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Appendix 3

Brief instructions

DISPLAYED RANGE

FH40F1 3µSv/h....999mSv/h
FH40F3 300µR/h....99,9R/h
Center of detector, see yellow symbol

KEY	DISPLAY	FUNCTION
◉	—	ON / OFF
🔊	🔊	BEEPER ON / OFF
○	—	ILLUMINATION ON / OFF

DISPLAY	MEANING
🔋 FLASHING	CHANGE BATTERY
ERR 🔋	DEAD BATTERY
ERR	SYSTEM ERROR
🔊 FLASHING + BEEPER	ALARM : to silence press 🔊

Alarm : FH40F1 25µSv/h ; FH40F3 2,5 mR/h

II. Accessories for FH 40 F Radiameter

External Probes

The probes specified below may be connected to the FH 40 F directly or via a probe cable (1,25 m long, draw. no. 42 482/0040).
See Fig. 8 and 9.

Connecting an external probe to the meter, the internal counter-tube of the FH 40 F is switched off automatically, and the proper measuring range for the external probe is set.

External Probes

Use	Dose rate measurements					Alpha-Beta-Contamination		
Type of probe	FHZ 120 Low range	FHZ 130 High range	FHZ 131 Underwater probes	FHZ 310 Underwater probes	FH 40 FE Teleprobe	FHZ 140 Contamination	FHZ 731 Pancake	FHZ 173 Beaker
Display range	1 µR/h ... 999 mR/h 0,01 µSv/h ... 9,99 mSv/h	10 mR/h ... 999 R/h 0,1 mSv/h ... 9,99 Sv/h	300 µR/h ... 99,9 R/h 3 µSv/h ... 0,99 Sv/h	300 mR/h ... 10000 R/h 3 mSv/h ... 100 Sv/h	0,1 mR/h[1] ... 999 R/h 1 µSv/h ... 9,99 Sv/h	max. 1000 s^{-1} or 100000 cpm		
Energy range	45 keV ... 1,3 MeV	80 keV ... 3 MeV	80 keV ... 3 MeV		40 keV ... 3 MeV	Alpha> 2 MeV Beta > 100 keV		- >500 keV
Accuracy	± 20 %	± 20 %	± 20 %	± 20 %		-	-	-
Overload [2]	100 x	100 x	100 x	10 x	100 x	100 x	100 x	100 x
Window	-	-	-	-	-	<2mg/cm² 20 mm Ø	<2mg/cm² 45 mm Ø	35mg/cm² 100 mm Ø
Diameter [mm]	35	35	45	45	-	35	85x110	65
Length [mm]	140	110	155	185	800-4000	125	115	180
Weight [g]	130	100	1350[3]	1350[3]	2000	110	1100	420

1) in 2 ranges 2) max. 1 min 3) incl. 20 m cable

Useful accessories:

- Manual sample changer FH 40 P for probe FHZ 731,
  Maximum sample diameter 60 x 8 mm
- Detector cable with 1.25 - 5 - 10 - 15 or 20 m length
- External line driver for cable longer than 1.25 m
- Transparent one-way plastic bag for contamination protection
- Small case for the FH 40 F or large case for the FH 40 F and accessories

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III. Measurement of gamma radiation with external probes

With the meter switched off the external probe should be connected either directly or with interconnection of a probe cord to the 6 pole socket (7) of the FH 40 F; see fig.1.

The standard probe cord is 1,25 m long. If required, lengths up to a maximum of 5 m are available.

During measurement the longitudinal side of the probe should be facing the radiation source.

High Dose Gamma Probe FHZ 130

draw. no. 42 482/31

Application:

Measuring of γ dose rate

Measuring range:

0,1 mSv/h ... 9,99 Sv/h or

10 mR/h ... 999 R/h

Energy range:

50 keV ... 3 MeV

Counter-tube:

ZP 1300

Remarks:

Probe model FHZ 130 A, draw. no. 42 482/36 with built-in cable driver for cable lengths up to 20 m

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Low Dose Gamma Probe FHZ 120
draw. no. 42 482/33

Application:
Measuring of γ dose rate

Measuring range:
0,01 µSv/h ... 9,99 mSv/h or
1 µR/h ... 999 mR/h

Energy range:
45 keV ... 1.3 MeV

Counter-tube:
ZP 1200

Remarks:

Probe model FHZ 120 A, draw. no. 42 482/43 with built-in cable driver for cable lengths up to 20 m.

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Medium Dose Gamma Probe FHZ 131

draw. no. 42 482/39

Application:

Measuring of γ dose rate below water surface (max. depth 20 m)

Measuring range:

3 µSv/h ... 999 mSv/h or

300 µR/h ... 99,9 R/h

Energy range:

80 keV ... 3 MeV

Remarks:

Waterproof connection cable, draw. no. 42 482/4005, length 20 m

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High Dose Gamma Probe FHZ 310
draw. no. 42 482/40

Application:
Measuring of γ dose rate below water surface (max. depth 20 m)

Measuring range:

indication	0,1 mSv/h ... 3,33 Sv/h
≙ dose rate	3 mSv/h ... 100 Sv/h for K = 30 *)

or

indication	10 mR/h ... 333 R/h
≙ dose rate	300 mR/h ... 10000 R/h for K = 30 *)

*) The dose rate D at the location of the probe may be calculated by the indicated value according to the relation

$$D = K \cdot A$$

The correction factor K has an approximate size of 30. Its individual amount may be taken from the manufacturer's test certificate.

Energy range:
80 keV ... 3 MeV

Remarks:
Waterproof connection cable, draw. no. 42 482/4005, length 20 m

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Telescopic Probe "Telesonde" FH 40 FE

draw. no. 42 485/50

Application:

Measuring of γ dose rate at distant and hard accessible places.

(Telescope length max. 4 m)

Measuring range:

low dose rate - 1 µSv/h ... 10 mSv/h
or 1 mR/h ... 1 R/h

high dose rate - 0,1 mSv/h ... 9,99 Sv/h
or 10 mR/h ... 999 R/h

Energy range:

40 keV ... 3 MeV

Remarks:

Meter FH 40 F is inserted into Telesonde FH 40 FE; no connection cable.

See Fig. 9

22.01.1991 Lorenz/mü Rev.B

10012 3 D 1933

Brief instructions for Telesonde FH 40 FE

INSTRUCTION FH 40 FE

- PUT FH40F INTO TELESCOPING PROBE FRAME
  ROTATE PLUG - ADJUSTMENT AS REQUIRED
- PULL TELESCOPE AS REQUIRED

KEY	FUNCTION
	ON / OFF
	BEEPER ON / OFF
	ILLUMINATION ON / OFF

For more details see instruction manual

TELESCOPING PROBE- SWITCH

Center position : probe low dose range
Left position : probe high dose range
Right position : internal detector FH 40F

Note : Range depends on model FH 40 F

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IV. Measurement of alpha-beta-gamma contaminations with external probes

For detection of alpha and beta radiation, particularly of surface contamination, there is the FHZ 140 alpha-beta-gamma external probe which is fitted with the LND 7231 end-window counter tube.

An additional external probe, the FHZ 173 beta-gamma glass bulb probe is used for measurement of liquid samples and bulk materials.

The two probes, the FHZ 140 and FHZ 173, are connected to the FH 40 F radiameter by means of a probe cord in the same way as the external gamma probes. When this is done the letters "EXT" (for external probe) and the symbol "β" for the type of radiation measured appear in the display. In addition the radiameter is automatically switched over to a readout range of 0 to 1000 s^{-1}.

The pulse readout can also be used for calibration of the measuring assembly and for determination of radioactivity.

Alpha-beta- contamination checking of surface

Checking of surface for radioactive contamination due to alpha and beta radiation sources can be carried out by direct measurement and by the wipe test method.

The FHZ 140 alpha-beta-gamma probe with the integral LND 7231 end window counter tube (thickness of window: 1,5 ... 2,0 mg/cm²) permits the use of both methods.

Whilst for beta measurement a probe window - object distance of a few cm is sufficient, alpha contamination can only be detected by placing the probe directly on the surface to be checked.

Important !

When placing on the surface to be examined there is a risk of the probe being contaminated !

On no account may dirt be allowed to reach the protective filter on the alpha-beta-gamma probe, as the window material underneath is extremely sensitive and may not be cleaned.

Ensure that no water reaches the end window of the alpha-beta-gamma probe.

Alpha-Beta-Gamma Probe FHZ 140

draw. no. 42 482/34

Application:

Detection of α-, β-, and γ-radiation, particularly of surface contaminations and wipe test samples.

Measuring range:

0,01 ... 999 cps

Counter-tube:

LND 7231

Remarks:

Window 29 mm Ø; 1,5 ... 2,0 mg/cm²

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Alpha-Beta-Gamma Pancake Probe FHZ 731

draw. no. 42 482/38

Application:

Detection of weak to medium α-, β-, and γ-contaminations on surfaces;
measuring of wipe test samples.

Measuring range:

0,01 ... 999 cps

Counter-tube:

LND 7311/8767

Remarks:

Window 45 mm Ø

Available accessories:

Tungsten shield draw. no. 42 482/3800-11
Sample slider FH 40 P, draw. no. 42 482/41
for wipe test samples up to 60 mm Ø

Hints for maintenance:

If the protective grid at the probe window side has been polluted, remove it carefully and clean it.

For removing the grid proceed as follows:

a) Grid ring <u>with notch</u> at rim:
Put a fingernail into the notch and lift the grid from magnetic support.

b) Grid ring <u>without notch:</u>

Press the ring using a palm and turn it by about 60 degrees. Then the magnetic support will release the ring.

<u>Caution !</u>

Don't touch the sensitive detector window !

When mounting the grid ring to the probe, at first fasten it carefully by one of the three magnets and then set it correctly.

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Measurement of contamination of liquids

The FHZ 173 beta-gamma glass bulb probe is used for determining the contamination level or the radioactivity of liquids and bulk materials.

The counter tube is located centrally in a cylindrical glass measuring vessel. As comparable measurement can only be carried out if constant measuring conditions are maintained with each measuring process, the measuring vessel of the probe has a calibrated capacity of 100 cc.

The counter tube is beta and gamma-sensitive; the thickness of the glass wall is approx. 25 ... 35 mg/m².

As the FHZ 173 probe is sensitive to light, the appropriate cover must always be screwed on for measurement.

The FHZ 173 gamma-beta probe can become contaminated itself through contact with contaminated liquid, particularly when certain radionuclides undergo exchange reactions with the wall of the detector or of the measuring vessel. As a result it is possible for the background to increase with prolonged use, which results in deterioration of measuring sensitivity.

The beta-gamma probe must be thoroughly cleaned each time after use (rinse out witch distilled water). If further decontamination is necessary, it is advisable for the liquid counter tubes to use a mixture consisting of 4 parts of 10 % nitric acid and one part of alcohol with the addition of a commercially available detergent.

It should be pointed out that the FHZ 173 probe has a coating on the inside of the glass which is in some cases visible as a grey-yellow deposit. When cleaning the vessel it is important to note that this coating is not any form of pollution.

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FAG Kugelfischer Georg Schäfer KGaA

FAG FH 40 F1-F4 RADIAMETER

Beta-Gamma Glass Bulb Probe FHZ 173
draw. no. 42 482/35

Application:

Measuring of liquid samples and bulk materials.

Measuring range:

0,01 ... 999 cps

Counter-tube:

FHZ 73

Remarks:

Volume of measuring vessel 100 ml;
glass wall approx. 25 ... 35 mg/cm²

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V. Other Accessories

Probe connection cable 1.25 m
draw. no. 42 482/0040

Probe connection cable 5 m *)
draw. no. 42 482/0041

Probe connection cable 10 m *)
draw. no. 42 482/0042

Probe connection cable 15 m *)
draw. no. 42 482/0043

Probe connection cable 20 m *)
draw. no. 42 482/0044

Cable driver
draw. no. 42 482/42

Test source FH 35 D, 333 kBq ≙ 9 µCi Cs-137
draw. no. 49 931/0105

Support for test source
draw. no. 42 482/5150

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*) only together with cable driver 42 482/42

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FAG FH 40 F RADIAMETER

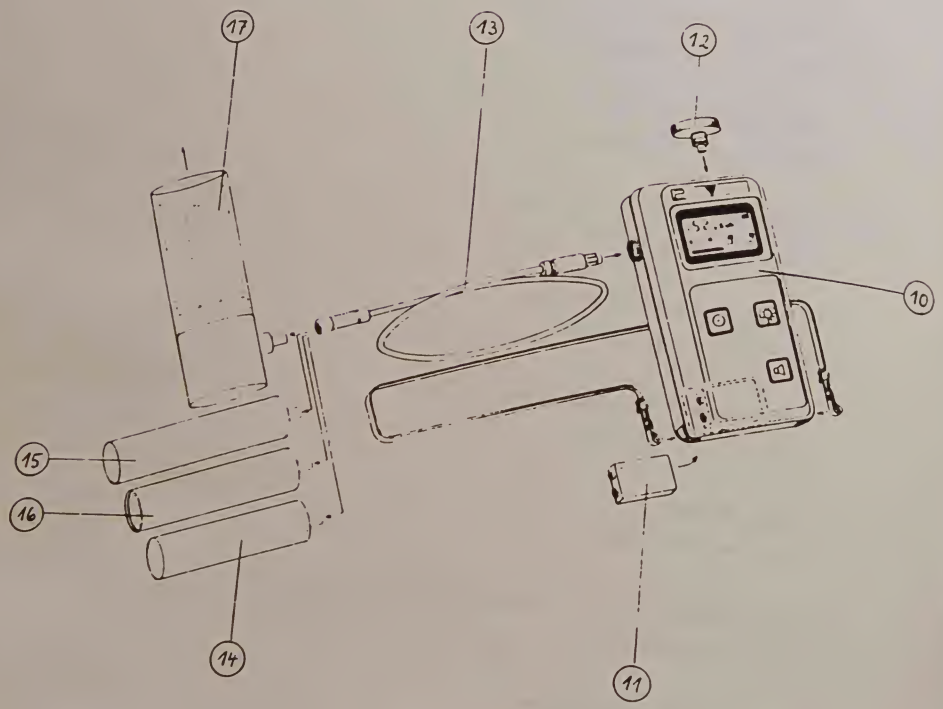

Fig. 8

FAG Kugelfischer Georg Schäfer
Kommanditgesellschaft auf Aktien

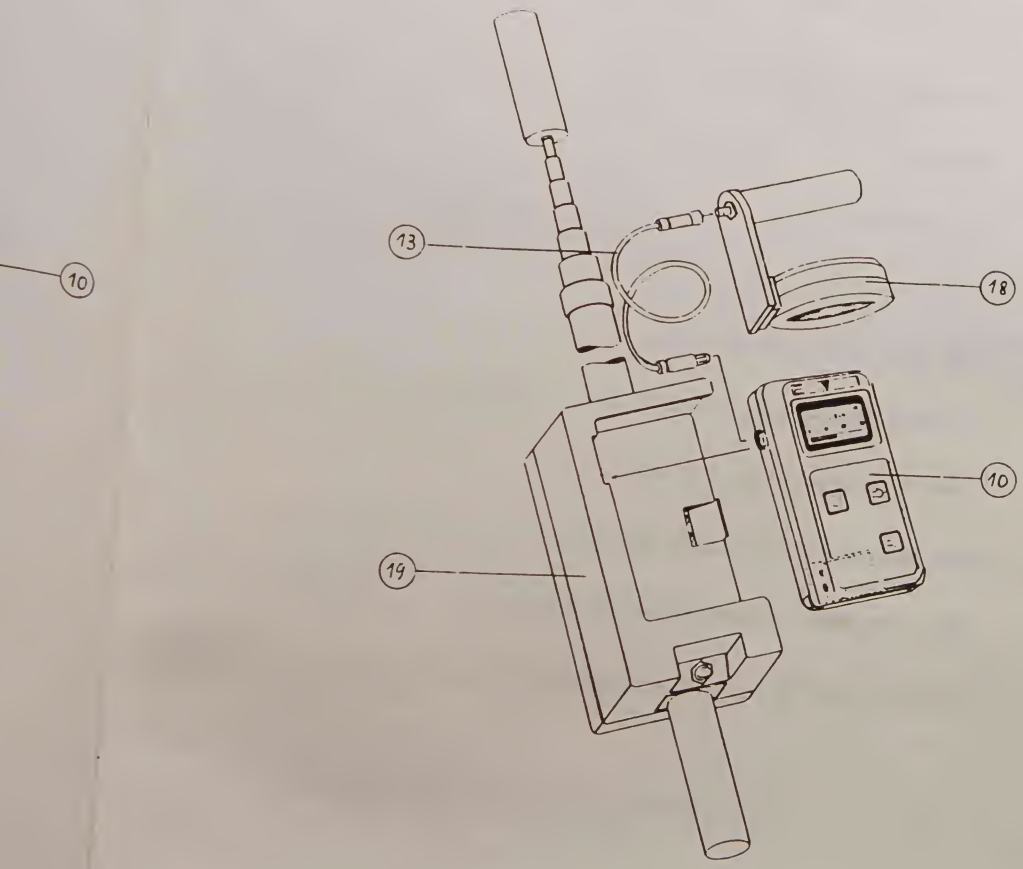

Fig. 9

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Explanation for fig. 8 and 9

(10) Radiameter FH 40 F

(11) Battery

(12) Test source FH 35 D

(13) Probe connection cable

(14) High dose gamma probe FHZ 130

(15) Low dose gamma probe FHZ 120

(16) Alpha beta gamma probe FHZ 140

(17) Beta gamma glass bulb probe FHZ 173

(18) Alpha beta gamma pancake probe FHZ 731

(19) Telesonde FH 40 FE

VI. Radiameter FH 40 F5 and FH 40 F6

The radiameters FH 40 F5/F6 are special versions of the standard models FH 40 F3/F4 differring from these by the indication if having connected a high dose gamma probe FHZ 310 or one of the beta probes:

External probe	Indication	
	FH 40 F3/F4	FH 40 F5/F6
Probe FHZ 310 at dose rate > 1000 R/h, e.g. 3000 R/h	100 R/h *)	3.00 R/h x 1000
Beta probe	0 ... 999 s^{-1}	0 ... 99900 cpm

*) at a correction factor K = 30; see page 41

For the FH 40 F5/F6 models the following alarm thresholds are provided:

FH 40 F5 100 mR/h
FH 40 F6 2 mR/h

The alarm thresholds are only effective, if switch S21 on processor board = ON.

As to all other functions as well as to the connecting facilities the models refer to each other as follows:

FH 40 F5 ≙ FH 40 F3 (HD range 300 µR/h ... 100 R/h)

FH 40 F6 ≙ FH 40 F4 (LD range 1 µR/h ... 1 R/h)

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Radiameter FH 40 F1 ... F6
Technical Data - Summary

	FH 40 F1	FH 40 F2	FH 40 F3	FH 40 F4	FH 40 F5	FH 40 F6
Displayed range	3 µSv/h ...999 mSv/h	0,01 µSv/h ... 9,99 mSv/h	300 µR/h ... 99,9 R/h	1 µR/h ... 999 mR/h	300 µR/h ... 99,9 R/h	1 µR/h ... 999 mR/h
Approved range (PTB) 1)	200 µSv/h ... 0,99 Sv/h	0,5 µSv/h ... 9,9 mSv/h	20 mR/h ... 99 R/h	50 µR/h ... 0,99 R/h		
Energy range 2)	40 keV ... 3 MeV	45 keV ... 1,3 MeV	40 keV ... 3 MeV	45 keV ... 1,3 MeV	40 keV ... 3 MeV	45 keV ... 1,3 MeV
Polar response	+/- 20 % for angle of +/- 45°					
Temperatur range 3)	-30 to +50 °C / -20 to 120 °F					
Power supply	Battery 9 V, IEC 6 LF 22					
Battery lifetime	> 70 h continuous use at background, without scale illumination					
Battery check	at low voltage : 1) intermittent battery sign 2) display "ERR. BATT."					
Audible Alarm	Soundlevel > 75 dB(A)					
Size	160 x 85 x 40 mm / 6.3 x 3.3 x 1.6 in					
Weight	ca. 500 g / 16 ounces with battery					
Protection class	Splash water proof DIN 40050, IP 65					
External γ-probes	Sv/h	Sv/h	All models with autoranging R/h	R/h	R/h	R/h
External α-, β-probes	s^{-1}	s^{-1}	All models with autoranging s^{-1}	s^{-1}	cpm	cpm

1)Physikalisch-Technische Bundesanstalt 2)Limit values < ± 30% 3)Limit values < ± 20%

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VII. Subject index

Subject index (contin.)

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Subject index (contin.)


ŁADOWANIE
004145
FH 40F4
40 KeV... 3 MeV
35,5 µ R/h
0
50
100
ANZEIGEBER. 3µSv/h... 999mSv/h
FAG